CHAPTER 1

SYSTEM OVERVIEW

SECTION I. DESCRIPTION AND LEADING PARTICULARS

1.1.1 INTRODUCTION

The Automated Surface Observing System (ASOS) automatically collects weather data and provides accurate, 24-hour accumulated weather reports to local weather observers; weather forecasters; airport personnel, including pilots and air traffic controllers (ATC's); and Federal Aviation Administration (FAA) and National Weather Service (NWS) personnel. ASOS functions include: measurement of weather elements, data processing and display, communication, and data storage (archiving). The ASOS is a flexible system with a modular construction that allows deployment in a variety of configurations for operation with or without the attendance of an observer. Unattended, the ASOS automatically collects, processes, and error checks data and formats, displays, archives, and reports the weather elements included in a surface weather observation. The ASOS also accepts inputs from observers (when present), who may also override or add information to the automatically generated observation. Because of the flexibility of the ASOS, it can provide useful weather information in text, video, and audio format to a variety of users. table 1.1.1 lists the users with which the ASOS can interface.

Table 1.1.1. ASOS Users

User Name	Description
Automation of Field Operations and Services (AFOS)	National Weather Service (NWS) forecasters use the AFOS outputs from the acquisition control unit (ACU) to perform their duties. ASOS provides hourly surface meteorological reports (METAR's), Aerodrome Forecasts (TAF's), and special weather reports (SPECI's) to any AFOS user. Local AFOS users receive data via direct connection (hardwire). Remote AFOS users receive data through telephone lines. These terminals are not the ASOS technician's responsibility.
Airline displays	One-minute weather observations, in the International Civil Aviation Organization (ICAO) METAR format are available from the ACU for distribution to up to 50 airline displays located throughout the airport complex. The airline displays receive reports and forecasts through coaxial cables connected to a single jack on the ACU. These terminals are not the ASOS technician's responsibility.
Controller Video Displays (CVD's)	Federal Aviation Administration (FAA) CVD's serve air traffic controllers (ATC's) in the tower. Up to nine displays may receive data from a single ASOS. The CVD's receive METAR's, 1-minute altimeter data, 5-second wind data, and density altitude data (when greater than 1000 ft).
FAA radio	ASOS produces a computer-generated voice message from the last METAR (hourly surface observation report), or from the current 1-minute observation. The voice message is generated continuously, with five seconds delay between the completion of one message and the beginning of the next. The voice message is output to a radio communications link for transmission to aircraft in the VHF frequency range. The operator interface device (OID) provides FAA ATC's with the ability to select the broadcast product (i.e., last METAR hourly report or current 1-minute observation).
Dial-In reports	The ASOS computer-generated voice message (see FAA radio above) is also output for up to eight telephone lines to provide audio reports for dial-in callers.

Table 1.1.1. ASOS Users -CONT

User Name	Description
Operator Interface Device (OID)	The OID is used to receive minute-by-minute data (including hourly, local, and special observations) and all data requested from the OID. Up to three OID's are provided with the ASOS. The primary OID has priority over the secondary OID's. When an observer is signed on at the primary OID, changes to system data cannot be made via the secondary OID's. One of the two secondary OID's can be equipped with an FAA handset. The handset is used to generate voice messages which can be added to the continuous FAA radio transmission. The FAA handset interfaces to the ACU via direct connection (hardwire).
Remote users	Up to five dial-in ports provided with the ACU can be used to allow remote users to perform all OID functions and to send/receive information such as minute-by-minute weather data, archive information, maintenance data, and diagnostics results. Users interface with the ACU via telephone lines and a remote computer terminal. When accessing the ASOS remotely via a modem hookup, the user cannot perform observer or ATC level input functions. The five remote user ports are identified as follows: a. User phone 1 (OID #4) b. User phone 2 (OID #5) c. User phone 1 spare (OID #6) d. User phone 2 spare (OID #7) e. OID spare (OID #8)
Video display units (VDU's)	Up to four local VDU's provide 1-minute observations for various airport personnel. VDU's are capable of operating up to 200 feet from the ACU.
Tower computer control complex (TCCC)	For future use.
Advanced weather information processing system (AWIPS)	AWIPS uses the AWIPS output from the acquisition control unit (ACU). ASOS provides routine, hourly surface meteorological reports (METAR's), SPECI weather reports, and SHEF reports to AWIPS. ASOS also provides the latest one-minute observation (OMO) when requested by AWIPS. Local AWIPS users receive data via direct connection (hardwire). Remote AWIPS users receive data through telephone lines.
FAA ADAS	The FAA ADAS Data Acquisition System (ADAS) both transmits and receives messages with the ASOS via the FAA ADAS port at the acquisition control unit (ACU). Messages to the FAA ADAS are translated into the ADAS format before transmission. ASOS provides METAR hourly reports and unscheduled SPECI reports to the FAA ADAS via phone line. In addition, the FAA ADAS receives and disseminates Lightning Detection Data (LDD) to the ASOS.
RVR	At selected sites, the acquisition control unit (ACU) provides a port to interface a Runway Visual Range (RVR) computer. The RVR computer sends RVR data to ASOS at a minimum rate of once per minute via a dedicated hardwire link or phone line.

1.1.2 **PURPOSE OF THIS MANUAL**

This manual provides site maintenance personnel with the primary source of technical information required for the maintenance of the ASOS. The ASOS theory of operation and troubleshooting data are presented to enable maintenance personnel to quickly remedy any problem and return the system to an operational
$ condition. This manual is divided into 16 chapters, parts list, and maintenance drawings which are described
$ in the following paragraphs.

1.1.2.1 **Chapter 1, System Overview**. Chapter 1 provides system level maintenance data for the ASOS. The Chapter is divided into five sections: description, installation, operation, theory, and maintenance. Chapter 1 contains all system level maintenance procedures and, therefore, should be referenced first when fault isolating the ASOS.

1.1.2.2 **Chapter 2, Acquisition Control Unit (ACU)**. Chapter 2 provides the physical description, theory of operation, installation, and maintenance procedures for the ACU subsystem of the ASOS, including all peripherals. Notice that the standard ASOS ACU includes a built-in local Data Collection Package (DCP) function which can support up to three locally sited sensors, where sensor data and control are interfaced via fiberoptic modules.

1.1.2.3 **Chapter 3, Data Collection Package (DCP)**. Chapter 3 describes the data collection package (DCP) processing system. Theory of operation and installation, operating, and maintenance procedures are provided for the rf link, uninterruptible power supply (UPS), modem, sensor processors, power supplies, and environmental enclosure cooling system. Each DCP cabinet supports up to 16 sensors and is designed for unsheltered installation remote from the ACU. At airports, DCP cabinets will generally be sited near the approach end of runways. The standard ASOS ACU also can serve as a local DCP for up to three sensors that are situated close to the shelter in which the ACU is installed.

1.1.2.4 **Chapters 4 through 13 and 16, Sensors and Subsystems**. Chapters 4 through 13 and 16 provide maintenance information on the ASOS sensors and subsystems, including: introduction, physical description, specifications, installation, theory of operation, and maintenance. Chapter assignments are as follows: $

a. Chapter 4, Wind Sensors
b. Chapter 5, Temperature/Dewpoint (Model H083/1088) Sensors
c. Chapter 6, Visibility Sensor
d. Chapter 7, Present Weather Sensor
e. Chapter 8, Ambient Pressure Sensor
f. Chapter 9, Cloud Height Sensor (Ceilometer)
g. Chapter 10, Liquid Precipitation Accumulation Sensor (Rain Gauge)
h. Chapter 11, Freezing Rain Sensor
i. Chapter 12, Ground-to-Air Radio
j. Chapter 13, Codex 3600 Series Modem
k. Chapter 16, Thunderstorm Sensor $

1.1.2.5 **Chapter 14, Single Cabinet ASOS (SCA)**. Chapter 14 describes the Single Cabinet ASOS (SCA) system. Theory of operation and installation, operating, and maintenance procedures are provided for the rf link, uninterruptible power supply (UPS), modem, sensor processors, power supplies, and environmental enclosure cooling system. The SCA cabinet contains both the ACU and DCP combined into one cabinet and is designed for unsheltered installation. The SCA uses the same sensors and peripherals as the standard ASOS.

1.1.2.6 **Chapter 15, Port-Sharing Device (PSD)**. Chapter 15 describes the Port Sharing Device software task that runs in the ACU. The PSD enables the single port on the remote terminal to AFOS to communicate with both ASOS and the auxiliary backup terminal (ABT).

1.1.2.7 **Parts List**. The parts list (located after the last chapter) provides a listing of all repair parts, including assemblies, subassemblies, and parts common and peculiar to the ASOS. The listing includes: item name, Federal Stock Number (FSN), Federal manufacturer's code, manufacturer's part number, and recommended initial stock quantities. A cross-reference from the FSN to manufacturer's stock numbers is also included, which provides alternate sources for procurement where applicable.

1.1.2.8 **Maintenance Drawings**. The maintenance drawings section (located after the parts list in volume II) describes the formats used on oversize maintenance drawings contained in this manual. These drawings include detailed block diagrams, power distribution drawings, and cabling diagrams.

1.1.3 SCOPE OF THIS MANUAL

This manual provides all information necessary for on-site maintenance support of the ASOS, which includes preventive maintenance, operation, fault isolation, and removal/installation of field replaceable units (FRU's). To enable site maintenance personnel to quickly locate the maintenance procedures for the various subsystems of the ASOS, each subsystem is described in a separate Chapter as described in paragraph 1.1.2. To further aid maintenance personnel, each Chapter follows the same format. Chapters consist of five major sections whose order and basic content are as follows:

1.1.3.1 **Section I, Description and Leading Particulars**. Section I provides an introduction to the system/subsystem and should be referenced to gain a general understanding of the system or to obtain physical descriptions and locational information.

1.1.3.2 **Section II, Installation**. Section II provides information on the method of replacing the individual subsystem. This information is provided on the assumption that the subsystem was previously installed by the factory installation team, and that all mounting hardware and electrical wiring are in place.

1.1.3.3 **Section III, Operation**. Section III provides the procedures to power on/off, initialize, determine operational status, and operate a system/subsystem. This information enables maintenance personnel to effectively utilize the ASOS. Standard operating procedures are provided in the ASOS Software User's Manual.

1.1.3.4 **Section IV, Theory of Operation**. Section IV provides detailed theory of operation for a system/subsystem and includes basic and detailed block diagrams.

1.1.3.5 **Section V, Maintenance**. Section V provides corrective and preventive maintenance procedures for a system/subsystem. Procedures are provided for cleaning and inspection, adjustment/calibration, troubleshooting through the use of diagnostics, and removal/replacement of failed FRU's. Section V should be referenced when troubleshooting or performing scheduled maintenance on the ASOS.

1.1.4 ASOS SYSTEM DESCRIPTION

Figure 1.1.1 illustrates a typical ASOS installation. The system consists of an acquisition control unit (ACU), up to three data collection packages (DCP's), sensors that gather weather information, and user terminals. The ACU receives sensor data from the DCP(s); analyzes, compiles, and logs the data; and provides the data to the various ASOS users. All interfacing with the ASOS is accomplished via the ACU. The DCP controls the data collection process. It receives data from the individual sensors, formats the data, and transmits the data to the ACU. The DCP also provides and controls all primary electrical power to the sensors. The sensors gather the weather information. The sensor complement can consist of up to 16 sensors per remote DCP. These sensors perform specialized functions to gather raw data regarding weather and atmospheric conditions. These data typically include temperature, wind, and precipitation. The sensors are then either polled by the DCP or automatically transfer their data to the DCP where the data are incorporated into the ASOS data processing scheme. In addition to the sensors connected to the remote DCP, up to six sensors can be connected directly to the ACU. These sensors are referred to individually as local sensors, or collectively as the local DCP. The first three local sensor slots are reserved for pressure sensors contained inside the ACU. Any of the other types of ASOS sensors can be connected to local sensor ports 4, 5, and 6 of the ACU.

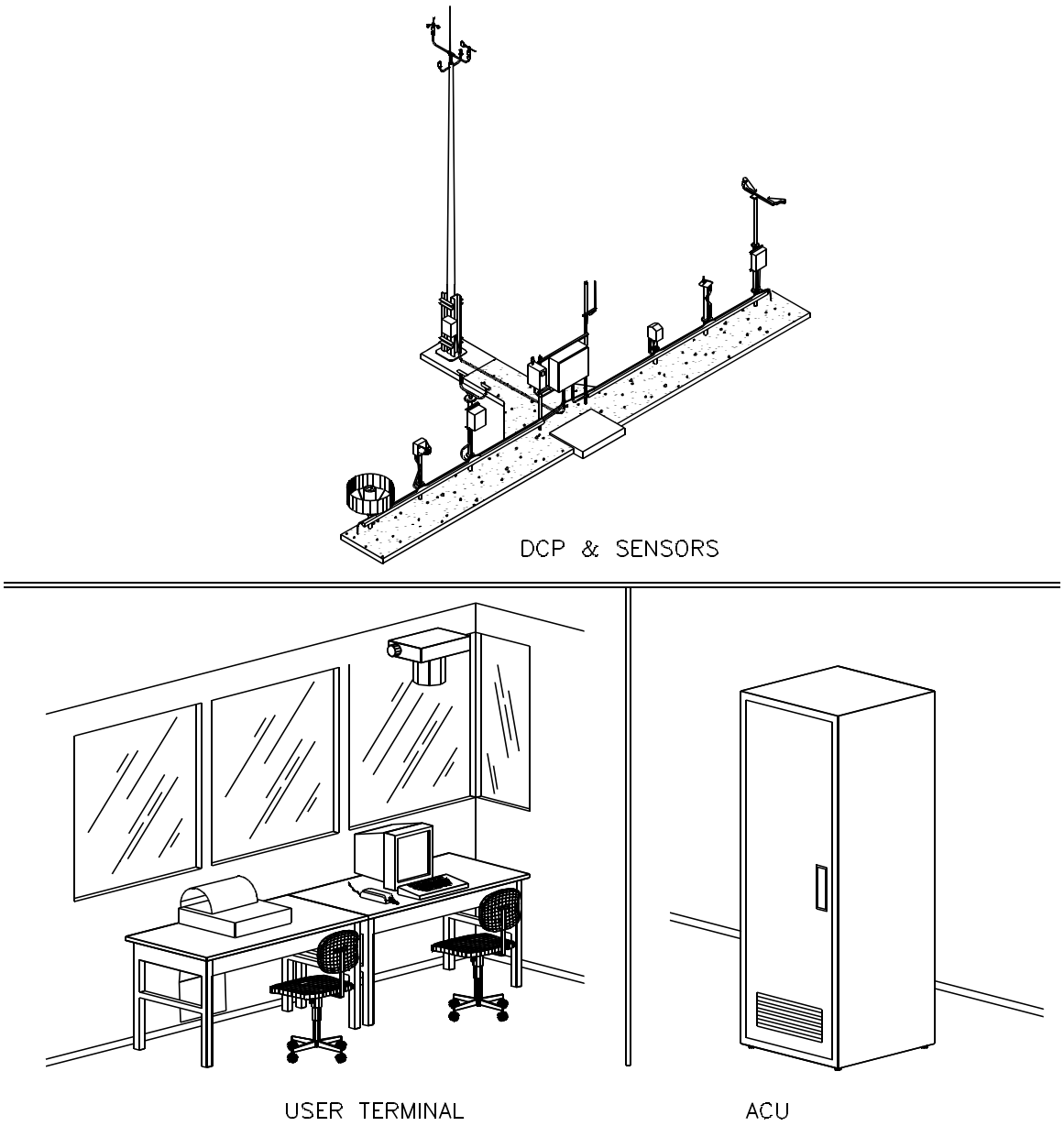

Figure 1.1.1. Typical ASOS

1.1.5 **SYSTEM CONFIGURATIONS**

Each ASOS is configured to meet the specific requirements at each individual site. The present configuration of a site can be reviewed by accessing the site configuration screens via the OID or a remote terminal. The site maintenance manual provides maintenance documentation for all possible assemblies and subassemblies in the ASOS but does not relate to any specific configuration. The technician should consult the configuration screens and site specific documentation to make determinations such as sensor configuration, number of OID and user terminals, sensor pad configuration, and facility power and signal cable routing.

1.1.6 RELATED PUBLICATIONS

In addition to this manual, the ASOS is supported by the following manuals:

a. ASOS Software User's Manual - Provides detailed information on ASOS operation and all ASOS OID screens.

b. ASOS Ready Reference Guide - Provides operator reference information for system operation.

c. Link MC70 User's Guide - Provides vendor support information for the OID.

d. Panasonic dot matrix printer model KX-P1180i, KX-P2180, or KX-P3123 Operating Instructions Manual - Provides vendor support information for the dot matrix printer.

e. UDS 2440 Installation and Operation - Provides vendor support documentation for the model 2440 stand-alone telephone modems.

f. UDS V.3225 Installation and Operation - Provides vendor support documentation for the model V.3225 stand-alone telephone modems.

g. UDS V.3400 Installation and Operation - Provides vendor support documentation for the model V.3400 stand-alone telephone modems.

h. Motorola DDS/MR64 Installation and Operation - Provides vendor support documentation for the model DDS/MR64 line driver.

1.1.7 SYSTEM SPECIFICATIONS

ASOS system specifications are provided in table 1.1.2.

Table 1.1.2. System Specifications

Sensor	Limits	Accuracy	Resolution
Wind Speed	0 to 125 knots	±2 knots or 5%, whichever is greater	1 knot
Wind Direction	Winds ≥5 knots Winds 2 to 5 knots	±5° - Winds must be displaced more than 5°	1 degree
Temperature	-80°F to +130°F	±1.8° for readings between -58°F and 122°F. ±3.6° for readings between -80°F and -58°F. ±3.6° for readings between 122°F and 130°F.	0.1°F
Dewpoint	.0°F ≤ TS < 10.8°F**	±2° for dewpoint readings: Td > 32°F. ±3.4° for dewpoint readings: 32°F ≥ Td > -0.4°F. $ ±4.5° for dewpoint readings: -0.4°F ≥ Td ≥ -31°F.	0.1°F
	10.8°F ≤ TS <14.4°F**	±2.2° for dewpoint readings: Td > 32°F. ±3.4° for dewpoint readings: 32°F ≥ Td >-0.4°F. $ ±4.5° for dewpoint readings: -0.4°F ≥ Td ≥ -31°F.	
	14.4°F ≤ TS <16.2°F**	±2.3° for dewpoint readings: Td > 32°F. ±3.6° for dewpoint readings: 32°F ≥ Td >-0.4°F. $ ±4.5° for dewpoint readings: -0.4°F ≥ Td ≥ -31°F.	
	16.2°F ≤ TS < 18.0°F**	±2.5° for dewpoint readings: Td > 32°F. ±3.8° for dewpoint readings: 32°F ≥ Td >-0.4°F. $ ±4.5° for dewpoint readings: -0.4°F ≥ Td ≥ -31°F.	

*,** See notes at the end of table

Table 1.1.2. System Specifications -CONT

Sensor	Limits	Accuracy	Resolution
Dewpoint (cont)	18.0°F ≤ TS < 19.8°F**	±2.7° for dewpoint readings: Td > 32°F. ±4.1° for dewpoint readings: 32°F ≥ Td > -0.4°F. ±4.5° for dewpoint readings: -0.4°F ≥ Td ≥ -31°F.	
	19.8°F ≤ TS < 21.6°F**	±2.9° for dewpoint readings: Td > 32°F. ±4.5° for dewpoint readings: 32°F ≥ Td > -31°F.	
	21.6°F ≤ TS < 23.4°F**	±3.1° for dewpoint readings: Td > 32°F. ±5.0° for dewpoint readings: 32°F ≥ Td ≥ -31°F.	
	23.4°F ≤ TS < 25.2°F**	±3.2° for dewpoint readings: Td > 32°F. ±5.4° for dewpoint readings: 32°F ≥ Td ≥ -31°F.	
	25.2°F ≤ TS < 27.0°F**	±3.4° for dewpoint readings: Td > 32°F. ±5.8° for dewpoint readings: 32°F ≥ Td ≥ -31°F.	
	27.0°F ≤ TS < 28.8°F**	±3.6° for dewpoint readings: Td > 32°F. ±6.3° for dewpoint readings: 32°F ≥ Td ≥ -31°F.	
	28.8°F ≤ TS <30.6°F**	±3.8° for dewpoint readings: Td > 32°F. ±6.7° for dewpoint readings: 32°F ≥ Td ≥ -31°F.	
	30.6°F ≤ TS < 36.0°F**	±4.5° for dewpoint readings: Td > 32°F. ±7.9° for dewpoint readings: 32°F ≥ Td ≥ -31°F.	
	36.0°F ≤ TS < 45.0°F**	±5.6° for dewpoint readings: Td > 32°F. ±7.9° for dewpoint readings: 32°F ≥ Td ≥ -0.4°F. ±9.9° for dewpoint readings: -0.4° ≥ Td ≥ -31°F.	
	45.0°F ≤ TS < 54.0°F**	±6.8° for dewpoint readings: Td > 32°F. ±11.9° for dewpoint readings: 32°F ≥ Td ≥ -31°F.	
	54.0°F ≤ TS < 63.0°F**	±7.9° for dewpoint readings: Td > 32°F. ±13.9° for dewpoint readings: 32°F ≥ Td ≥ -31°F.	
Pressure	16.9" to 31.5" of mercury	±0.02" of mercury	0.0003"
Visibility*		<u>For 80% of measurements</u>	--
	Up to 1¼ miles	±¼ mile	
	1½ to 1-3/4 miles	±¼, -½ mile	
	2 to 2½ miles	±½ mile	
	3 to 3½ miles	±½, -1 mile	
	4 to 10 miles	±1 report increment	
		<u>For 98% of measurements</u>	
	Up to 1¼ miles	±½ mile	
	1½ to 1¾ miles	±½, -¾ mile	
	2 to 2½ miles	±1 mile	
	3 to 3½ miles	+2 reporTable increments, -1 mile	
	4 to 10 miles	+2 reporTable increments	
Rain Accum	0 to 10.0"/hr	±0.02" or 4% of hourly total, whichever is greater	0.01"
Snow Depth	0 to 99"	0 - 5": ±½" >5 - 99": ±1"	½" 1"

*,** See notes at the end of table

Table 1.1.2. System Specifications -CONT

Sensor	Limits	Accuracy	Resolution
Frozen Precip Water Equiv	0 to 40"	±0.04" or 1% of the total accumulation	0.01"
Freezing Rain Occurrence	--	Detection is reported whenever freezing rain accumulates to 0.01".	--
Ceilometer	0 to 12,650 ft	±100 ft or 5%, whichever is greater	50 ft
$ $ Thunderstorm	0-5, 5-10, 10-30 miles	100% for thunderstorms within 10 miles with 3 or more cloud-to-ground discharges	--
Present Weather	Occurrence 99% of time Identification: Rain 90% of time Snow 97% of time Precip 99% of time	0.01"/hr or 10%, whichever is greater	

* Accuracy requirements for 80% of the measurements. For the remaining 20% of the measurements, double the requirements.

** Temperature spread (TS) equals temperature minus dewpoint temperature.